FOREST PEST MANAGEMENT
Pacific Southwest Region

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Report No. C93-8

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# EVALUATION OF FOREST INSECT PESTS ON THE TULE RIVER INDIAN RESERVATION

John M. Wenz
Entomolgist

## Background

The purpose of this report is to provide entomological follow-up to a Forest Pest Management (FPM) Biological Evaluation of the Tule River Indian Reservation conducted on May 20 and 21, 1991 (ref. FPM Report No. C91-4, July 10, 1991). As is the case with many forested areas throughout the Sierra Nevada, the Tule River Indian Reservation has experienced above normal levels of drought-related coniferous mortality over the past several years. The report covers the most important insects associated with the mortality and provides a discussion of potential management alternatives.

## Insect Pests

Bark beetles (Coleoptera: Scolytidae) were found associated with virtually all the coniferous mortality scattered throughout the Reservation (The bark and engraver beetles observed during the evaluation and their hosts are listed in Appendix I; pest biologies are described in Appendix II). The mortality occurred as both scattered, individual, trees (e.g., mountain pine beetle in sugar pine), as well as in larger groups of 10-20 trees. The red turpentine beetle was commonly observed attacking the base of bark beetle-infested Jeffrey, ponderosa and sugar pines. In addition, pine engravers, Ips spp., were found attacking ponderosa pines growing in plantations located in the vicinity of Solo Peak. Fir engravers were associated with both mortality and top-killing of white fir.

Scattered, light, damage attributable to the gouty pitch midge, Cecidomyia piniinopsis (Diptera: Cecidomyiidae) was also found in the pine plantations. In addition, pitch masses, characteristic of the sequoia pitch moth, Vespamima sequoiae (Lepidoptera: Sesiidae), were seen on the boles of several pines in the plantations.

No significant defoliator activity was observed. However, a few old Douglas-fir tussock moth (DFTM), Orgyia pseudotsugata (Lepidoptera: Lymantriidae), cocoons were found on white fir saplings and poles adjacent to one of the pine plantations near Solo Peak. Only very light feeding injury from the previous year was seen and no new, current, egg masses were found.

Discussion and Pest Management Alternatives

1. No Management. The above normal bark beetle-related mortality experienced on the Tule River Indian Reservation over the past few years is due primarily to a combination of (a) the extended drought, (b) diseases and (c) stand conditions. These factors interact to weaken trees to the extent that they are increasingly susceptible to successful attack by bark beetles. A continued return to normal precipitation should, over a one to three year timeframe, help reduce the very high levels of mortality induced by drought stress. However, with no management action directed at managing or mitigating the other contributing factors, relatively high levels of mortality can be expected to continue on a somewhat localized, periodic, basis. More specifically, tree losses will likely continue unless the action is taken to manage stand conditions (primarily stocking control) as well as the diseases found on the Reservation, including annosus root disease, dwarf mistletoes, and white pine blister rust. Mortality levels will fluctuate from year-to-year, but will likely be higher than would be expected if management actions are implemented.

2. Bark/Engraver Beetle Management. Considerable cooperative research involving the use of pheromones for bark/engraver beetle population manipulation is being conducted throughout the western U.S. and Canada. However, for the bark beetles of primary concern to the Reservation, there are currently no biologically effective, economically feasible, environmentally acceptable methods available that have been shown to control area-wide bark beetle populations such that subsequent tree mortality is consistently reduced to acceptable levels. At the present time, the best approach to reducing/preventing bark and engraver beetle-related mortality is through vegetation and disease management that mitigates the predisposing factors.

A) Stocking control. The objective is to thin overstocked stands and vegetation aggregations to levels appropriate for the site. The intent is to create and maintain healthy and vigorously growing trees and stands that can prevent successful bark beetle attacks. Timely implementation of thinning operations can be applicable to both established stands, depending on age and condition, as well as plantations.

B) Sanitation/Disease Management. In addition to stocking control, removal of selected trees that will not likely respond to thinning should improve the overall vigor of the stand and reduce the potential for bark beetle attack. This can include removing trees with physical injuries, poor needle retention, diseases, live crowns of less than 20-30% of the tree height, current top-kill of more than 20-30% of the live crown, and current branch dieback that affects at least 50% of the live crown. The decision to remove individual trees through thinning and/or sanitation for pest management purposes should be made within the context of resource management goals and objectives. Specific options for managing the diseases

found on the Reservation were discussed in the August 16, 1992 evaluation report (C91-4).

C) Slash Management. Pine engraver beetles attack and breed in fresh, green, slash greater than 2" in diameter. Populations that develop in the slash have the potential to emerge and attack nearby standing trees causing top-kill which can predispose the trees to subsequent attack by Dendroctonus spp. In the case of plantations, pine engraver attack can result in either top-kill or mortality. Minimizing the amount of suitable engraver breeding habitat (green slash) will prevent Ips spp. population build-up and reduce the risk of attack on trees in the residual stand. Methods include chipping and lopping and scattering green slash to promote drying which makes the slash unsuitable for engraver brood development. Piling green slash is not advisable if the material cannot be burned or otherwise destroyed within 35-40 days because the slash located on the inner part of the pile often does not dry out very quickly and remains suitable for brood development (see also discussion of pine engraver beetle biology, Appendix II).

3. Sequoia pitch moth. Large pitch masses, caused by larvae of the sequoia pitch moth boring in the cambium region, were observed on the boles of several pines in the Solo Peak plantations. The pitch moth is usually considered a pest of ornamentals. The damage in the plantations was not associated with any tree mortality but repeated attacks sometimes occur and can result in damage to smaller diameter trees. No direct action appears warranted at this time. It is suggested that the plantations be monitored to detect any increasing damage (increasing incidence of pitch moth, branch dieback, top-kill, mortality) associated with the pitch moth and determine the need for subsequent action. Depending on results of the monitoring, trees damaged by the sequoia pitch could be considered for removal during thinning/sanitation operations.

4. Gouty pitch midge. Light, scattered, damage (somewhat deformed, twisted, crowns and branches and some tip dieback) to pines by the gouty pitch midge was observed in the Solo Peak plantations. Extended, severe, infestations occasionally kill smaller, unthrifty, trees and may cause some growth loss. However, experience with the midge in central and northern California pine plantations, indicates that factors like soil type, seed source, and growing conditions (competition) have a greater effect on tree growth than even moderate to heavy pitch midge infestations. In plantations located in the southern Cascades of California,, the midge is apparently more an indicator of poor growing conditions than a cause of poor growth itself. Gouty pitch midge populations tend to fluctuate markedly from year to year. As with the sequoia pitch moth, it is suggested that the plantations be monitored to detect increasing damage from the gouty pitch midge and the potential need for subsequent action.

5. Douglas-fir tussock moth. Populations of the Douglas-fir tussock moth are currently at low, non-damaging, levels. There is no historical record of a DFTM outbreak occurring on the Tule Indian Reservation, although susceptible stands (stands with at least 50% white fir between 4500-6500 ft) are present. A pheromone-based, detection system for the DFTM is implemented on an annual basis in California and elsewhere throughout the west in an effort to provide an "early warning" of when and where the tussock moth is going to enter an outbreak cycle. Early detection allows adequate time for NEPA analyses and

decision-making. If the Tule River Indian Reservation would like to participate in the system, they should contact the FPM- South Sierra Shared Service Area.

6. Integrated Management. The above insect management alternatives are not necessarily mutually exclusive. It is appropriate that they be considered along with the disease management options detailed in evaluation report C91-4 when incorporating pest management considerations into overall management resource management plans.

## APPENDIX I

### Bark and Engraver Beetles Observed on the Tule River Indian Reservation and Their Coniferous Hosts

| Bark/Engraver Beetle(s) | Host(s) |
|---|---|
| Western pine beetle (*Dendroctonus brevicomis*) | Ponderosa pine |
| Mountain pine beetle (*D. ponderosae*) | Sugar pine<br>Ponderosa pine<br>Lodgepole pine |
| Jeffrey pine beetle (*D. jeffreyi*) | Jeffrey pine |
| Red turpentine beetle (*D. valens*) | All western pines |
| Pine engraver beetles (*Ips* spp.) | All western pines |
| Fir engraver beetle (*Scolytus ventralis*) | White and red fir |

## APPENDIX II

## Biologies

### Western Pine Beetle

The western pine beetle, Dendroctonus brevicomis, breeds in the main bole of living ponderosa and Coulter pine larger than about 4 inches dbh. Normally it breeds in trees weakened by drought, overstocking, root disease, dwarf mistletoe or fire.

Adult beetles emerge and attack trees continuously from spring through fall. Depending on the latitude and elevation, there can be from one to four generations per year. The generations are difficult to distinguish because the prolonged period of initial attack and re-emergence of parent females to establish additional broods causes considerable overlapping of the generations.

Initial attacks are made about mid-bole and subsequent attacks fill in above and below. Pheromones released during a successful attack attract other western pine beetles. Attacking beetles may spill over onto nearby apparently healthy trees and overwhelm them by sheer numbers. Pitch tubes and red boring dust are indications of successful attacks.

Adults bore a sinuous gallery pattern in the cambium and the female lays eggs in niches along the sides. The larvae feed in the inner bark for a short distance and then turn into the outer bark to complete development.

Bluestain fungi introduced during successful attacks probably contribute to the rapid mortality associated with bark beetle attacks.

Woodpeckers, predaceous beetles and low winter temperatures cause natural control. Silvicultural activities that result in rapid, vigorous tree growth increases tree resistance and prevents mortality. Individual high value trees undergoing a temporary reversible stress, such as drought, can be protected for up to a year by applying insecticides to the bole.

### Mountain Pine Beetle

The mountain pine beetle, Dendroctonus ponderosae, attacks the bole of ponderosa, lodgepole, sugar and western white pines larger than about 4 inches dbh. Extensive infestations have occurred in mature lodgepole pine forests. Group killing often occurs in mature forests and young overstocked stands of ponderosa, sugar and western white pines.

The life cycle of the mountain pine beetle varies considerably over its range. One generation per year is the general rule, with attacks occurring from late June through August. Two generations per year may develop in low elevation sugar pine.

Attacks may extend from the root collar up to near the top. Pheromones released during a successful attack may attract enough beetles to result in a group kill. Pitch tubes and red boring dust in bark crevices or on the ground indicate successful attacks.

The adults bore long vertical egg galleries and lay eggs in niches along the sides of the gallery. A "J"-hook is common at the lower end of the gallery. The hatching larvae feed in mines perpendicular to the main gallery and construct small pupal cells at the end of these mines where they pupate and transform into adults.

The sapwood of successfully attacked trees soon becomes heavily bluestained. The bluestain fungi probably aid in overcoming the defenses of the host tree.

Natural factors affecting the abundance of the mountain pine beetle include low winter temperatures, nematodes, woodpeckers and predaceous and parasitic insects. As stand susceptibility to the beetle increases because of age, overstocking, diseases or drought, the effectiveness of natural control decreases and mortality increases. Relieving stress by thinning dense stands can prevent some group kills. Individual high value trees undergoing temporary reversible stress may be protected from attack by application of insecticide to the bole.

## Jeffrey Pine Beetle

The Jeffrey pine beetle, Dendroctonus jeffreyi, is the principle bark beetle found attacking Jeffrey pine, Pinus jeffreyi, which is its only host. It is a native insect occurring from southwestern Oregon southward through California and western Nevada to northern Mexico. The beetle normally breeds in slow-growing, stressed trees. The beetles prefer trees which are large, mature, and occur singly rather than in groups. Yet when an epidemic occurs, the beetle may attack and kill trees greater than 8 inches in diameter, regardless of age or vigor. Often the beetle infests lightning-struck or wind-thrown trees, but does not breed in slash.

Presence of the beetle is usually detected when the foliage changes color. The color change of the foliage is related to the destruction of the cambium layer by the beetle. Generally, the top of the crown begins to fade in a slow sequence, with the needles turning from greenish yellow, to sorrel, and finally to reddish brown. By the time the tree is reddish brown, the beetles have usually abandoned the tree. Another sign of beetle attack is large, reddish pitch tubes projecting from the bark of the infested tree.

Jeffrey pine beetles have a distinctive "J" shape egg gallery pattern on the inner bark. Larval mines extend across the grain and end in open, oval-shaped pupal cells. The beetle has a 4 life stages, egg, larva, pupa, and adult. The adults are stout, cylindrical, black, and approximately five-sixteenths of an inch long when mature. The egg is oval and pearly-white. The larva is white, legless, and has a yellow head. The pupa is also white but is slightly smaller than the mature larva. The life cycle is normally completed in one year in the northern part of the range, but in the southern part, two generations per year may occur. The principle period of attack is in June and July, but attacks also are frequent in late September and early October.

Several other organisms are associated with the attack of the Jeffrey pine beetle. Bluestain fungi, yeasts, and other fungi are transferred into the tree by the attacking adults. The California flatheaded borer, Melanophila californica, the pine engraver, Ips pini, and the emarginate ips, I. emarginatus, may precede the Jeffrey pine beetle or attack the tree at the same time.

Natural enemies, climatic factors, and the tree's own resistance, normally keep the Jeffrey pine beetle population in check. Losses in stands can be kept to a minimum by removing the types of trees the beetle prefers, ie. sick, stressed, wounded. The remaining trees may be protected through a sanitation-salvage cutting, preferably before the beetle can emerge from the tree. Other options may be to fell the tree and burn it, peel the bark off or spray the tree. If the beetle has reached the pupal stage, peeling the bark to expose the insect will be ineffective.

## Red Turpentine Beetle

The red turpentine beetle, Dendroctonus valens, occurs throughout California and can breed in all species of pines. It normally attacks injured, weakened or dying trees and freshly cut stumps. The adults are attracted by fresh pine resin. They often attack wounded trees in campgrounds or following logging, trees scorched by wildfire or prescribed burns, lightning-struck trees and root-diseased trees exhibiting resinosis.

Attacks usually occur at the soil line or root crown and are characterized by a large reddish pitch tube at the point of entry. On severely stressed trees or during periods of drought, attacks may occur underground on the main roots up to 15 feet from the bole and also on the bole to a height of 10 feet. If an attack is successful, the adults excavate an irregular gallery in the cambium and the female lays eggs along the sides. The larvae feed in a mass and destroy an area of cambium ranging from 0.1 to 1.0 square feet. Attacks do not always kill trees but may predispose them to attack by other bark beetles. Repeated or extensive attacks by the red turpentine beetle can kill pines.

Attacks occur throughout warm weather and peak at mid-summer. The number of generations varies from two years for a single generation at the coldest portions of its range to two or three per year in the warmest.

Attacks can be minimized or prevented by avoiding soil compaction and injury to standing trees during logging or construction and also by insecticide application to high value trees.

## Pine Engraver Beetles

Pine engraver, Ips spp., attacks have been recorded on most species of pines in California. These beetles kill saplings, poles and sawtimber up to about 26 inches dbh and the tops of even larger trees. Attacks on live trees are usually limited to trees which are suppressed, or stressed by dwarf mistletoe, root disease, drought, fire or the attack of other insects. If fresh slash is

available in the spring, pine engravers may build up in an area and cause localized mortality or top killing by mid-summer.

Attacks are made with the coming of warm weather in the spring. Attacking males bore nuptial chambers in the inner bark and release a pheromone which attracts other beetles to the attack site. If many beetles are attracted, they may attack nearby trees and cause a group kill. Within a day or two of the attack by the male, two to five females enter the nuptial chamber and after mating, each female bores an individual egg gallery which lightly scores the sapwood. The size and pattern of the combined gallery pattern is often diagnostic of the species of Ips involved. The galleries are kept open by beetles pushing boring dust out through the entrance hole. Red boring dust collecting in bark crevices or spider webs is diagnostic of a successful attack. Eggs are laid in niches along the sides of the galleries. Larvae hatch from the eggs and feed in the phloem. They eventually pupate in cells at the end of their larval mines and transform to adults.

A new generation is produced in as little as 6-8 weeks in the spring to 4-6 weeks in mid-summer (August). Thus, several overlapping generations per year may be produced. The winter may be passed in any of the life stages of larvae, pupae, or adults, depending upon which Ips species is involved.

Outbreaks in standing, healthy trees are sporadic and of short duration, and are often associated with some temporary stress or shock afflicting the host species, such as drought or logging disturbance. Tree killing frequently occurs where green pine slash, which serves as breeding habitat is left untreated during spring and summer. To be suitable as pine engraver breeding habitat, pine slash must have bark from 1/8 to 1 inch thick (usually 3 to 26 inches diameter), must have succulent cambium and must remain moderately cool during the development period.

Fresh pine slash caused by thinning, dwarf mistletoe control work, construction or winter storm breakage can be modified in a number of ways to make it unsuitable for pine engraver breeding. One approach to minimizing damage is to schedule slash-generating activities mostly between mid-July and late-December, when the slash has a high probability of drying out, heating up, or spoiling before the beetles can complete their development. Utilization of the cut material to the smallest possible diameter will minimize the amount of breeding material available to engraver beetles. If green pine slash must be created during the spring and early summer, slash treatments are available to prevent the buildup of pine engraver populations. Because pine engravers can complete their development in about a month under ideal conditions, treatment should be carried out soon after cutting to be effective.

Slash treatment methods which generally work well include chipping, lopping and scattering slash in sunny areas to heat it up, crushing or mashing slash with logging equipment to make it unsuitable for pine engraver breeding, or piling and burning the slash within a month of cutting. Broadcast burning the slash might work if it could be done without damaging the residual stand. A method which has worked during the summer in hot climates is to pile slash in a sunny area and tightly cover the pile with clear plastic. If the temperature under the bark of slash in all parts of the pile reaches 120$^{o}$F, all brood currently in the pile will be killed. Lower temperatures will not be effective and, where successful, this method will not prevent reinfestation of slash piles.

Because most pine engraver attacks occur within a quarter-mile from the location where the beetles emerged, high value pines can be given some protection by removing fresh pine slash to areas which do not have pines.

Two practices which should generally be avoided are piling fresh pine slash without further treatment, and allowing slash to touch or remain near valuable leave trees.

## Fir Engraver

The fir engraver (Scolytus ventralis) attacks both white and red fir in California. Trees ranging in size from large saplings to overmature sawtimber are susceptible. Attacks can cause patch-killing of cambium along the bole, top-kill, or tree death. Top-kill or death occur most often in firs that have been weakened by root disease, dwarf mistletoe, overstocking, soil compaction, sunscald, logging injury, or drought. The fir engraver also breeds in slash and windthrown trees.

The fir engraver usually completes its life cycle in one year, sometimes two. Adults fly and bore into trees or green fir slash from June to September; larvae, pupae, and adults over-winter under the bark. Pitch tubes are not formed as they are with pine bark beetles; the usual evidence of attack is boring dust in bark crevices along the trunk and pitch streamers on the mid and upper bole. Trees colonized early in the summer may begin to fade by early fall, but those colonized later in the year usually do not fade until the following spring or summer, often after the beetles have emerged.

## Gouty Pitch Midge

Adults of the gouty pitch midge, Cecidomyia piniinopsis, are small mosquito-like flies. Pitch midge adults emerge from late March through early May and lay eggs on expanding branch and leader tips of the primary host, ponderosa pine. The larvae that hatch from the eggs bore through the surface of the shoot and embed themselves in the vascular tissue. The larvae feed in resin-filled cavities until late winter or early spring when they crawl out of the feeding pits to pupate on the needles.

A few feeding pits on a shoot will have little effect on the tree, but as the number increases, growth and conduction will be affected. If the pits girdle the shoot, it will die. When the pits are distributed on only one side of the twig, the difference in growth rate causes a twisted branch or leader. The feeding pits cause a canker-like scar which remains visible on the twig for many years. Repeated infestations will reduce the growth rate, cause deformity and predispose the tree to attack by other organisms.

Trees under three years of age are seldom attacked. Foliage more than 16 feet high is only occasionally infested. Host tree vigor has little to do with susceptibility to the gouty pitch midge, but it will affect the impact of the infestation. The same level of infestation is more likely to produce twig and leader death in slowly growing trees than in rapidly growing ones.

The susceptibility of ponderosa pine to the gouty pitch midge is related to the type of surface of the spring shoots. During the period of active new growth, trees will exhibit one of three genetically controlled phenotypes. The shoots will either be resinous, dry and smooth, or covered with a waxy bloom. Trees with resinous shoots normally comprise about one-third of the population and are much more prone to serious pitch midge damage, although the midge is capable of developing in all three types.

Midge damage can be minimized in regeneration programs by avoiding ponderosa pine with resinous spring shoots for cone collections, seed trees or tree breeding projects. Damage will not be totally eliminated even if most of the regeneration display the less susceptible (dry and smooth or waxy) phenotypes because vegetative competition and population levels of the midge also influence the level of damage. When midge populations are very high, some trees displaying the unsusceptible phenotype will be attacked and conversely, when midge levels are low, some susceptible trees will escape attack.

## Sequoia Pitch Moth

The sequoia pitch moth, Vespamima sequoiae, is a clearwinged moth in the Family Sesiidae (Lepidoptera). The adults are black and yellow, resemble a wasp, and are characterized by having narrow wings that tend to be transparent and unscaled (hence the name "clearwinged" moth). The sequoia pitch moth ranges from British Columbia to Idaho, Montana and California. It attacks several species of Pinus, including ponderosa, lodgepole, Monterey and sugar pine. It also occasionally attacks Douglas-fir but has apparently not feed on Sequoia. It has a two year life cycle. The larvae bore into and feed in the cambium region causing copious pitch masses to form on the bole. Attacks are frequently associated with injuries and at the junctions of the limbs and the bole. It is generally considered an ornamental pest but repeated attacks over several years can cause significant damage, particularly to young, small-diameter, trees. The sequoia pitch moth has been recorded attacking young ponderosa pines pruned to create/maintain fuel breaks. The resulting pitch masses are considered to be somewhat of a fire hazard if prescribed burning is used to maintain the break.

Wenz 93-8

United States Department of Agriculture
Forest Service
Stanislaus National Forest
19777 Greenley Road
Sonora, CA 95370-5909
(209) 532-3671
FAX: (209) 533-1890

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JUN 25 1993

Mr. Floyd J. Franco, Jr.
Chairman
Tule River Tribal Council
Tule River Indian Reservation
PO Box 589
Porterville, CA 93258

Dear Mr. Franco:

Please find enclosed an evaluation report from the Forest Pest Management (FPM) South Sierra Shared Service Area. The report provides a follow-up to an FPM Biological Evaluation of the Tule River Indian Reservation conducted on May 20-21, 1991 (ref. FPM Report No. C91-4, July 10, 1991). Similar to many forested areas throughout the Sierra Nevada, the Tule River Indian Reservation has experienced above normal levels of drought-related mortality over the past few years. The current report discusses the most important insects associated with the mortality as well as potential management alternatives.

Please direct any questions to John Wenz, FPM Entomologist, at (209) 532-3671.

Sincerely,

JANET L. WOLD
Forest Supervisor

Enclosure

cc: Brian Rueger, Tule River Indian Reservation
J. Wenz